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• **CHO, Song-Yean**
16677 Suwon-si (KR)
• **CHOI, Sung-Ho**
16677 Suwon-si (KR)

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(74) Representative: **HGF**
HGF Limited
1 City Walk
Leeds LS11 9DX (GB)

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(71) Applicant: **Samsung Electronics Co., Ltd.**
Gyeonggi-do 16677 (KR)

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(72) Inventors:
• **LEE, Ji-Cheol**
16677 Suwon-si (KR)

(54) **METHOD AND APPARATUS FOR MANAGING PACKET DATA NETWORK CONNECTION ON BASIS OF LOCAL AREA IN WIRELESS COMMUNICATION SYSTEM**

(57) The present invention relates to a method and an apparatus for providing, setting, maintaining, and releasing a packet data network (PDN) connection on the basis of a local area in a wireless communication system. A method for enabling a terminal to set the PDN connection in the wireless communication system according to one embodiment of the present disclosure comprises the steps of: receiving the PDN subscription information on the basis of the local area from a business operator server; inspecting whether the current location information for the terminal exists in the PDN subscription information on the basis of the local area; and starting a procedure for setting the PDN on the basis of the local area when the current location information exists therein.

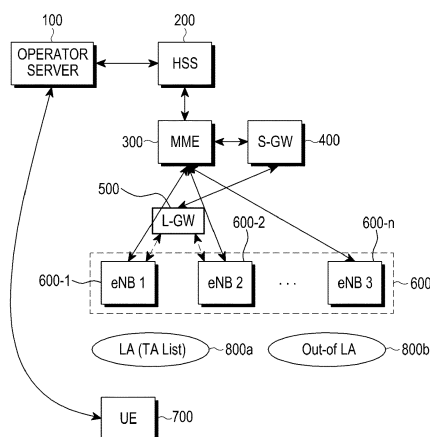


FIG. 1A

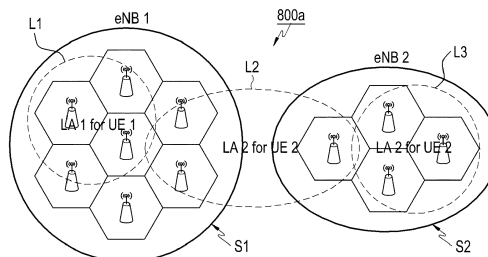


FIG. 1B

Description**Technical Field**

5 **[0001]** The present disclosure relates generally to a structure and procedure of a Local Area Packet Data Network (LA PDN), and more particularly, to a method and apparatus for providing, establishing, maintaining, and releasing a PDN connection based on a local area.

Background Art

10 **[0002]** Wireless communication systems have been developed to provide broadband data service such as multimedia service in addition to traditional voice service. Despite limited communication resources, various types of data services are demanded. Therefore, a more advanced wireless communication system is required.

15 **[0003]** To satisfy the demand, wireless communication systems that provide PDN-based enhanced services, such as a Long Term Evolution (LTE) system (or an Evolved Packet System (EPS)) proposed by the 3rd Generation Partnership Project 2 (3GPP2) have been deployed and have gained popularity.

[0004] A PDN may be deployed over a local area as well as a wide service area and research on specific procedures for operating a PDN in a local area is needed.

Disclosure**Technical Problem**

25 **[0005]** An aspect of the present disclosure devised to solve the conventional problem is to provide a method and apparatus for establishing a Local Area (LA) Packet Data Network (PDN) connection in a wireless communication system.

[0006] Another aspect of the present disclosure is to provide a method and apparatus for releasing an LA PDN connection in a wireless communication system.

[0007] Another aspect of the present disclosure is to provide a method and apparatus for maintaining an LA PDN connection in a wireless communication system.

30 **[0008]** Another aspect of the present disclosure is to provide a method and apparatus for reestablishing an LA PDN connection in a wireless communication system.

Technical Solution

35 **[0009]** In an aspect of the present disclosure, a method for establishing a Packet Data Network (PDN) connection by a User Equipment (UE) in a wireless communication system includes receiving Local Area (LA) PDN subscription information from an operator server, determining whether current location information about the UE is included in the LA PDN subscription information, and in the presence of the current location information about the UE in the LA PDN subscription information, starting an LA PDN establishment procedure.

40 **[0010]** In another aspect of the present disclosure, a UE for establishing a PDN connection in a wireless communication system includes a receiver configured to receive LA PDN subscription information from an operator server, and a controller configured to determine whether current location information about the UE is included in the LA PDN subscription information, and in the presence of the current location information about the UE in the LA PDN subscription information, to control starting of an LA PDN establishment procedure.

45 **[0011]** In another aspect of the present disclosure, a method for updating subscription information about a UE by an MME that manages mobility of the UE in a wireless communication system includes, if LA PDN subscription information about the UE is updated, receiving the updated LA PDN subscription information from an operator server, determining whether current location information about the UE is included in an LA PDN context including a TA list of the UE, and in the presence of the current location information about the UE in the LA PDN context, transmitting information indicating the update of the LA PDN subscription information to the UE.

50 **[0012]** In another aspect of the present disclosure, an MME for managing mobility of a UE in a wireless communication system includes a communication interface configured to transmit and receive messages for updating LA PDN subscription information, and a controller configured, if LA PDN subscription information about the UE is updated, to control reception of the updated LA PDN subscription information from an operator server, to determine whether current location information about the UE is included in an LA PDN context including a TA list of the UE, and in the presence of the current location information about the UE in the LA PDN context, to control transmission of information indicating the update of the LA PDN subscription information to the UE.

[0013] In another aspect of the present disclosure, a communication method of a BS during handover of a UE using

a PDN in a wireless communication system includes, if the UE performs handover to a target BS within an LA in connected state, determining whether current location information about the UE is included in an LA PDN context, and in the presence of the current location information about the UE in the LA PDN context, transmitting a handover request message including an LA PDN context related to the handover to the target BS.

[0014] In another aspect of the present disclosure, a BS for supporting handover of a UE using a PDN in a wireless communication system includes a communication interface configured to transmit and receive messages related to the handover of the UE, and a controller configured, if the UE performs handover to a target BS within an LA in connected state, to determine whether current location information about the UE is included in an LA PDN context, and in the presence of the current location information about the UE in the LA PDN context, to transmit a handover request message including an LA PDN context related to the handover to the target BS.

[0015] In another aspect of the present disclosure, a method for releasing a PDN connection by an MME that manages mobility of a UE in a wireless communication system includes receiving a TAU request from the UE, determining whether current location information about the UE is included in an LA PDN TA list, and in the absence of the current location information about the UE in the LA PDN TA list, starting an LA PDN disconnection procedure.

[0016] In another aspect of the present disclosure, a method for releasing a PDN connection by an MME that manages mobility of a UE in a wireless communication system includes determining whether current location information about the UE is included in an LA PDN TA list, and in the absence of the current location information about the UE in the LA PDN TA list, maintaining an LA PDN context of the UE until expiration of an LA PDN context retain timer.

[0017] In another aspect of the present disclosure, a method for reestablishing a PDN connection by an MME that manages mobility of a UE in a wireless communication system includes receiving a service request message from the UE that returns to an LA, transmitting an initial context setup request message including an LA PDN context and an LA bearer context of the UE to a BS, and transmitting a bearer modify request for LA PDN reconnection of the UE to a serving gateway.

[0018] In another aspect of the present disclosure, a method for reestablishing a PDN connection by an MME that manages mobility of a UE in a wireless communication system includes receiving a TAU request from the UE that performs handover in connected state from a source BS outside an LA to a target BS within the LA, determining whether current location information about the UE is included in an LA PDN context before expiration of an LA PDN context retain timer, and in the presence of the current location information about the UE in the LA PDN context, transmitting to the target BS a bearer setup request including an LA PDN context and a bearer context.

Brief Description of the Drawings

[0019]

Fig. 1a illustrates an exemplary wireless communication system that deploys a Local Area (LA) Packet Data Network (PDN) according to an embodiment of the present disclosure;

Fig. 1b illustrates an exemplary configuration of LAs according to an embodiment of the present disclosure;

Fig. 2 is a diagram illustrating a signal flow for a procedure for updating LA PDN subscription information in a wireless communication system according to an embodiment of the present disclosure;

Figs. 3a, 3b, and 3c are diagrams illustrating signal flows for an exemplary triggering method in an LA PDN establishment procedure in a wireless communication system according to an embodiment of the present disclosure;

Fig. 4 is a diagram illustrating a detailed signal flow for an LA PDN establishment procedure according to an embodiment of the present disclosure;

Fig. 5 is a diagram illustrating a signal flow for a procedure for transmitting an LA PDN context during X2 handover according to an embodiment of the present disclosure;

Fig. 6 is a diagram illustrating a signal flow for a procedure for transmitting an LA PDN context during S1 handover according to another embodiment of the present disclosure;

Fig. 7 is a diagram illustrating a signal flow for an LA PDN disconnection procedure according to an embodiment of the present disclosure;

Fig. 8 is a diagram illustrating a signal flow for a deferred LA PDN disconnection procedure according to an embodiment of the present disclosure;

Fig. 9 is a diagram illustrating a signal flow for an LA PDN reconnection procedure according to an embodiment of the present disclosure;

Fig. 10 is a diagram illustrating a signal flow for an LA PDN reconnection procedure according to another embodiment of the present disclosure;

Fig. 11 is a block diagram of a User Equipment (UE) 700 according to an embodiment of the present disclosure; and

Fig. 12 is a block diagram of an evolved Node B (eNB) 600 according to an embodiment of the present disclosure.

Best Mode for Carrying Out the Disclosure

[0020] In embodiments of the present disclosure, a Packet Data Network (PDN) activated in a Local Area (LA) is defined as a Local Area Packet Data Network (LA PDN). The LA includes tracking areas in which a packet data service is available and each tracking area includes adjacent cells.

[0021] Fig. 1a illustrates an exemplary wireless communication system that deploys an LA PDN according to an embodiment of the present disclosure. The wireless communication system illustrated in Fig. 1 is an exemplary LA PDN deployed, for example, in a 3rd Generation Partnership Project (3GPP) Evolved Packet System (EPS).

[0022] Referring to Fig. 1a, an operator server 100 is a server of a communication operator or service operator that provides a packet data service. A Home Subscriber Server (HSS) 200 manages authentication information, subscription information, and service information about a User Equipment (UE) 700. It is assumed that the UE 700 is any UE accessing a PDN such as the Internet through a PDN GateWay (P-GW) like a Serving GateWay (S-GW) 400 and a Local GateWay (L-GW) 500. The UE 700 may communicate with other Internet Protocol (IP)-based communication devices (not shown) within a local network (that is, LA) 800a by creating a LIPA PDN connection through the L-GW 500. LIPA represents local IP access in an EPS. In an embodiment of the present disclosure, a LIPA PDN is an example of the LA PDN. However, it is to be clearly understood that the LA PDN of the present disclosure is not limited to the LIPA PDN. In other words, the embodiments of the present disclosure are applicable, for example, to various types of wireless communication systems in which an L-GW may be located near to an evolved Node B (eNB) as well as to Selective IP Traffic Offloading (SIPTO) or LIPA described in 3GPP TS 23.401.

[0023] In Fig. 1a, a Mobility Management Entity (MME) 300 is responsible for mobility and location registration of the UE 700 and management of a Tracking Area (TA) list for location management of the UE 700. The MME 300 is also responsible for a control plane for exchanging control information between the UE 700 and an Evolved Packet Core (EPC). If subscription information about a UE (a user) in an LA PDN (referred to as "LA PDN subscription information") is updated and the current location of the UE 700 is included in an LA PDN context, the MME 300 provides information indicating update of the LA PDN subscription information to the UE 700 in an embodiment of the present disclosure.

[0024] The EPC includes the MME 300, the S-GW 400, and the L-GW 500. The S-GW 400 acts as a reference point that is not changed at a network side during handover. In other words, even though the UE 600 moves between a plurality of eNBs 600, the S-GW 400 is not changed. The S-GW 500 provides a data bearer for a packet data service under the control of the MME 300. The L-GW 130 creates a LIPA PDN connection and assigns an IP address to the UE 500, upon request of the S-GW 500.

[0025] The eNBs 600 transmit messages used during procedures for establishing, maintaining, and releasing an LA PDN connection between the network and the UE 700. If the UE 700 performs handover within an LA, an eNB 600 checks whether current location information about the UE 700 is included in an LA PDN context. In the presence of the current location information about the UE 700, the eNB 600 provides an LA PDN context related to the handover to a target eNB to which the UE 700 moves.

[0026] In the embodiment illustrated in Fig. 1, it is assumed that other UEs (not shown) that do not use LIPA PDN connections use a general packet data service in a service area 800b other than an LA.

[0027] Fig. 1b illustrates an exemplary configuration of LAs according to an embodiment of the present disclosure.

[0028] Referring to Fig. 1b, one LA L1, L2, or L3 800a may be configured per UE 700. One eNB eNB1 or eNB2 may configure a plurality of LAs. In Fig. 1b, eNB1 configures two LAs L1 and L2 and eNB2 configures two LAs L2 and L3. An LA such as L2 may be configured to be overlapped between different eNBs eNB1 and eNB2.

[0029] After subscription information (that is, LA PDN subscription information) about a UE (a user) in a PDN (that is, an LA PDN) configured by adding the LAs 800a to an existing PDN is initially provided to the UE 700, the LA PDN subscription information may be updated dynamically. The LA PDN subscription information is also related to the configuration of the LA PDN. If the terminal 700 moves along a boundary of the LA 800a in an idle or activated state, the LA PDN connection may be activated or deactivated.

[0030] Hereinbelow, a detailed description will be given of how an LA PDN is configured initially or dynamically, established, maintained during movement of the UE 700, and disconnected according to an embodiment of the present disclosure.

[0031] A procedure for initially providing LA PDN subscription information according to an embodiment of the present disclosure will first be described below.

[0032] LA PDN subscription information about a UE is stored in a Universal Subscriber Identity Module (USIM) of the UE. The LA PDN subscription information includes at least one of a TA list, a Local Area Access Point Name (LA APN), a Local Area Identifier (LA ID), additional information, and existing PDN configuration data. The additional information may include an LA verbose name and an LA icon. Accordingly, LA PDN subscription information stored in the HSS 200 illustrated in Fig. 1a includes at least one of a TA list, an LA APN, an LA ID, and existing PDN configuration data.

[0033] A procedure for dynamically updating LA PDN subscription data or information according to the present disclosure will be described below.

[0034] The operator server 100 illustrated in Fig. 1a may update the LA PDN subscription information. If the MME 300 has an LA PDN context and current location information about the UE is included in the LA PDN context, the MME 300 may transmit a message for triggering a procedure for updating the LA PDN subscription information between the UE 700 and the operator server 100.

[0035] If the LA PDN subscription information stored in the UE 700 has been changed, the operator server 100 may update the LA PDN subscription information to the changed LA PDN subscription information. The UE 700 may request establishment or termination of an LA PDN connection to a network based on the updated LA PDN subscription information.

[0036] Fig. 2 is a diagram illustrating a signal flow for a procedure for updating LA PDN subscription information in a wireless communication system according to an embodiment of the present disclosure.

[0037] Referring to Fig. 2, the operator server 100 updates the LA PDN subscription information about the UE 700 using the LA 800a, stored in the HSS 200 in steps 201 to 209. Specifically, if the LA PDN subscription information about the UE 700 has been changed, the operator server 100 provides the updated LA PDN subscription information to the HSS 200 and the HSS 200 stores the updated LA PDN subscription information in step 201. In step 203, the HSS 200 transmits the updated LA PDN subscription information to the MME 300. In steps 201 and 203, the operator server 100 and the HSS 200 may transmit only the updated LA PDN subscription information or entire subscription information about the UE 700 including the LA PDN subscription information.

[0038] Then the MME 300 determines whether current location information about the UE 700 (for example, a current Tracking Area Indication (TAI) of the UE 700) is present in an LA PDN context managed by the MME 300 in step 205. The LA PDN context includes an LA APN, a TA list, and existing LA PDN information.

[0039] The LA PDN subscription information about the UE 700 includes existing PDN information and information about an area in which a PDN connection may be created. This LA PDN subscription information includes an APN, an LA ID, a TA list, an LA verbose name, an LA icon, and existing PDN subscription information. After receiving the updated LA PDN subscription information, the UE 700 determines whether the TAI indicating the current location is included in the updated LA PDN subscription information by checking the TAI indicating the current location of the UE 700 and the updated LA PDN subscription information. If the TAI is included in the updated LA PDN subscription information but the UE 700 is not currently connected to any LA PDN, the UE 700 may request creation of an LA PDN.

[0040] In the embodiment of the present disclosure, it is assumed that the LA PDN context includes the current location information about the UE 700. Subsequently, the MME 300 transmits information indicating that the LA PDN subscription information has been changed to the UE 700 in step 207 and transmits ACKnowledgement (ACK) information indicating that the MME 300 has received the updated LA PDN subscription information to the HSS 200 in step 209. Step 207 is performed so that the UE 700 may initiate an Over The Air (OTA) connection with the operator server 100 to receive the updated LA PDN subscription information. Step 207 is optional. Further, even though step 207 is not performed, the UE 700 may periodically request the updated LA PDN subscription information to the network and receive it from the network.

[0041] In step 211, the HSS 200 transmits confirmation information indicating that the LA PDN subscription information about the UE 700 has been updated to the operator server 100. The operator server 100 transmits the LA PDN subscription information to the UE 700 through a mobile communication network (OTA) in step 213. In step 215, the UE 700 determines whether the current location information indicating the current location of the UE 700, for example, the current TAI is included in the updated LA PDN subscription information received in step 213.

[0042] In the embodiment of the present disclosure, it is assumed that the current location information (TAI) is present in the updated LA PDN subscription information. In step 217, the UE 700 performs an LA PDN establishment procedure, which will be described later. Upon termination of communication in the LA, a later-described UE requested PDN disconnection procedure is performed in step 219.

[0043] According to an embodiment of the present disclosure, step 213 may be performed differently in the following two cases.

[0044] In the case where the current location information (TAI) about the UE 700 is included in the updated LA PDN subscription information but the UE 700 does not have an LA PDN context related to the current location information (TAI), the UE 700 starts an LA entry procedure by a UE requested PDN connectivity procedure. On the other hand, in the case where the current location information (TAI) about the UE 700 is not included in the updated LA PDN subscription information but the UE 700 has an LA PDN context related to the current location information (TAI), the UE 700 starts a UE requested PDN disconnection procedure.

[0045] With reference to Figs. 3A to 4, the LA PDN establishment procedure performed in step 217 of Fig. 2 will be described. Before describing the LA PDN establishment procedure, triggering of the LA PDN establishment procedure will first be described below.

[0046] Fig. 3a illustrates an exemplary triggering method in an LA PDN establishment procedure according to an embodiment of the present disclosure.

[0047] Referring to Fig. 3a, the UE 700 first performs an initial attach procedure defined in section 5.3.2.1 of 3GPP

TS 23.401 in step 311. The MME 300 downloads subscription information about the UE 700 from the HSS 200 in the initial attach procedure.

[0048] In step 313, the UE 700 determines whether its current location information (TAI) is included in an LA PDN context. In the presence of the current location information (TAI) in the LA PDN context, the UE 700 starts a UE requested PDN connectivity procedure defined in section 5.10.2 of 3GPP TS 23.401. If the UE 700 is allowed to establish an LA PDN, the MME 300 checks the subscription information about the UE 700. The above-described procedure of Fig. 3a may be understood as an attach-triggered PDN establishment procedure.

[0049] Fig. 3b illustrates another exemplary triggering method in an LA PDN establishment procedure according to an embodiment of the present disclosure.

[0050] Referring to Fig. 3b, when the UE 700 enters an LA in idle state in step 311, the UE 700 performs, for example, a Tracking Area Update (TAU) procedure using an active flag as defined in sections 5.5.5.1 & 5.3.3.2 of 3GPP TS 23.401. The MME 300 downloads LA PDN subscription information from an old MME (not shown) used before the UE 700 enters the LA or the HSS 200. The UE 700 determines whether its current location information (TAI) (the TAI includes a Tracking Area Code (TAC) indicating the current location of the UE 700) is included in the LA PDN subscription information. In the presence of the current location information (TAI) in the LA PDN subscription information, the UE 700 starts the UE requested PDN connectivity procedure defined in section 5.10.2 of 3GPP TS 23.401 in step 313.

[0051] If the UE 700 is allowed to establish an LA PDN, the MME 300 checks subscription information about the UE 700. The above-described procedure of Fig. 3b may be understood as a TAU-triggered PDN establishment procedure.

[0052] Fig. 3c illustrates another exemplary triggering method in an LA PDN establishment procedure according to another embodiment of the present disclosure.

[0053] Referring to Fig. 3b, when the UE 700 enters an LA in connected state, the UE 700 and the network perform, for example, an S1 handover or X2 handover procedure and an accompanying TAU procedure defined in sections 5.3.3.1 & 5.3.3.2 of 3GPP TS 23.401 in step 321. The MME 300 downloads LA PDN subscription information from an old MME (not shown) used before the UE 700 enters the LA or the HSS 200. The UE 700 determines whether its current location information (TAI) is included in the LA PDN subscription information. In the presence of the current location information (TAI) in the LA PDN subscription information, the UE 700 starts the UE requested PDN connectivity procedure defined in section 5.10.2 of 3GPP TS 23.401 in step 323. If the UE 700 is allowed to establish an LA PDN, the MME 300 checks subscription information about the UE 700. The above-described procedure of Fig. 3b may be understood as a handover & TAU-triggered PDN establishment procedure.

[0054] When the UE 700 enters an LA, the LA PDN establishment procedure may be initiated by one of the above three triggering methods according to the embodiment of the present disclosure. In the LA PDN establishment procedure, the MME 300 checks the LA PDN subscription information received from the HSS 200. If the LA PDN subscription information is valid, the MME 300 creates an LA PDN session with the L-GW 500 (that is, the P-GW). Then the MME 300 starts to establish an LA PDN bearer using an LA PDN context. The LA PDN context includes LA PDN information, a TA list, and an LA ID. After the LA PDN bearer is established, the eNB 600 maintains the LA PDN bearer context.

[0055] Fig. 4 is a diagram illustrating a detailed signal flow for an LA PDN establishment procedure, for example, a UE requested PDN connectivity procedure according to an embodiment of the present disclosure.

[0056] Referring to Fig. 4, the UE 700 determines whether its current location information (TAI) is included in LA PDN subscription information in step 401. In the embodiment of the present disclosure, it is assumed that the current location information (TAI) about the UE 700 is included in the LA PDN subscription information. In step 403, the UE 700 determines to start an LA PDN connectivity procedure and transmits an LA PDN connectivity request to the MME 300 by a Non Access Stratum (NAS) transport message.

[0057] Then, the MME 300 determines whether the current location information (TAI) about the UE 700 is included in an LA PDN context in step 405. In the embodiment of the present disclosure, it is assumed that the current location information (TAI) is included in the LA PDN context. In step 407, the MME 300 accepts the LA PDN connectivity request received from the UE 700 in step 403 and transmits a create session request message along with the LA PDN context to the S-GW 400.

[0058] The S-GW 400 transmits a create session request message along with the LA PDN context to the L-GW 500 (that is, the P-GW) in step 409. In step 411, the L-GW 500 (that is, the P-GW) which performs a PCC function creates a session for connection establishment for the UE 700 and transmits a create session response message to the S-GW 400. The S-GW 400 transmits a create session response message indicating reception of the create session response message in step 411 to the MME 300 in step 415. In step 417, the MME 300 allows LA PDN establishment for the UE 700 and transmits a bearer setup request along with the LA PDN context to the eNB 600 according to the embodiment of the present disclosure.

[0059] Subsequently, the eNB 600 transmits an RRC connection reconfiguration message to the UE 700 in step 419 and receives an RRC connection reconfiguration complete message from the UE 700 that has completed RRC connection reconfiguration in response to the RRC connection reconfiguration message in step 421. In step 423, the eNB 600 transmits a bearer setup response message to the MME 300 in response to the bearer setup request message received

in step 417.

[0060] In step 425, the UE 700 transmits a direct transfer message indicating PDN connection completion to the eNB 600. The eNB 600 transmits a message indicating the PDN connection completion of the UE 700 to the MME 300 in step 427. The MME 300 transmits a message requesting bearer establishment for the UE 700 that has completed the PDN connection establishment to the S-GW 400 in step 429 and the S-GW 400 establishes a bearer and transmits a response message indicating completion of the bearer establishment to the MME 300 in step 431.

[0061] In step 433, when determining that the bearer establishment is completed, the MME 300 transmits a notify request message to the HSS 200. The HSS 200 transmits a notify response message to the MME 300 in step 435.

[0062] In the above-described LA PDN establishment procedure illustrated in Fig. 4, the other steps except steps 401, 405, and 417 may be performed in the same manner as the UE requested PDN connectivity procedure defined in section 5.10.2 of 3GPP TS 23.401.

[0063] After the LA PDN connection establishment is completed according to the procedure of Fig. 4, the UE 700 may move to another eNB inside or outside the LA in active mode.

[0064] A source eNB to which the LA PDN connection has been established transmits an LA PDN handover context for the UE 700 to a target eNB to which the UE has moved (has performed handover). The LA PDN handover context includes the LA PDN context and an LA PDN bearer context. The LA PDN bearer context is a context including bearer configuration information for transmitting traffic received via an LA PDN connection. The LA PDN context and the LA PDN bearer context may be transmitted by an X2 handover request or S1 handover request message well known to the EPS. The S1 handover request message is transmitted from the source eNB to the target eNB through the MME 300.

[0065] With reference to Figs. 5 and 6, a procedure for transmitting an LA PDN context during handover according to an embodiment of the present disclosure will be described below.

[0066] Fig. 5 is a diagram illustrating a signal flow for a procedure for transmitting an LA PDN context during X2 handover according to an embodiment of the present disclosure. It is assumed herein that the UE 700 in connected state moves from a source eNB 600a to a target eNB 600b in the same LA.

[0067] Referring to Fig. 5, the UE 700 that moves to the target eNB 600b transmits a measurement report to the source eNB 600a in step 501 and the source eNB 600a checks whether current location information (TAI) about the UE 700 is included in an LA PDN context in step 503. In the embodiment of the present disclosure, it is assumed that the current location information (TAI) about the UE 700 is included in the LA PDN context.

[0068] In step 505, the source eNB 600a transmits a handover request message including an LA PDN handover context to the target eNB 600b. The LA PDN handover context includes an LA PDN context and an LA PDN bearer context. The LA PDN context includes an LA ID and a TA list, and the LA PDN bearer context includes related bearer IDs (for example, Evolved Radio Access Bearer (E-RAB) IDs).

[0069] A bearer configuration is modified and a communication path is switched from the source eNB 600a to the target eNB 600b in steps 507 to 523 according to a known X2 handover procedure of the 3GPP EPS. Therefore, steps 507 to 523 are not described herein in detail.

[0070] Fig. 6 is a diagram illustrating a signal flow for a procedure for transmitting an LA PDN context during S1 handover according to another embodiment of the present disclosure. It is assumed herein that the UE 700 in connected state moves from the source eNB 600a to the target eNB 600b in the same LA.

[0071] Referring to Fig. 6, the UE 700 that moves to the target eNB 600b transmits a measurement report to the source eNB 600a in step 601, and the source eNB 600a checks whether current location information (TAI) about the UE 700 is included in an LA PDN context in step 603. In the embodiment of the present disclosure, it is assumed that the current location information (TAI) about the UE 700 is included in the LA PDN context.

[0072] In step 605, the source eNB 600a transmits a handover request message including an LA PDN handover context to the target eNB 600b. The LA PDN handover context includes an LA PDN context, an LA PDN bearer context, and a bearer information list (for example, a System Architecture Evolution (SAE) Bearer Information List in the EPS). The LA PDN context includes an LA ID and a TA list.

[0073] [Table 1] below illustrates an exemplary transparent container including the LA PDN handover context of step 605.

[Table 1]

| IE/Group Name | Presence | Range | IE type and reference | Semantics description | Criticality | Assigned Criticality |
|------------------------------|----------|-------|-----------------------|-----------------------|-------------|----------------------|
| RRC Container | M | | OCTET STRING | | - | - |
| SAE Bearers information List | M | | | | YES | Ignore |

(continued)

| IE/Group Name | Presence | Range | IE type and reference | Semantics description | Criticality | Assigned Criticality |
|-------------------------------|----------|------------------------------|-----------------------|-----------------------|-------------|----------------------|
| >SAE Bearers information item | | 1 to <max no of SAEbearers > | | | EACH | Ignore |
| » SAE Bearer ID | M | | BIT STRING (SIZE(8)) | | - | - |
| >> DL forwarding | O | | 9.2.3.14 | | | |

[0074] Handover-related signaling is performed between the source eNB 600a and the target eNB 600b and between a source MME 300a and a target MME 300b in steps 607 to 633 according to a known S1 handover procedure of the 3GPP EPS. Therefore, steps 607 to 633 are not described herein in detail.

[0075] Now, a description will be given of an LA PDN disconnection procedure according to an embodiment of the present disclosure.

[0076] When the UE 700 moves in idle state or performs a handover procedure in connected state, the LA PDN disconnection procedure may be performed. The UE 700 and the network perform a TAU procedure during the LA PDN disconnection procedure.

[0077] Fig. 7 is a diagram illustrating a signal flow for an LA PDN disconnection procedure according to an embodiment of the present disclosure.

[0078] Referring to Fig. 7, the UE 700 starts a TAU procedure for LA PDN disconnection in step 701 and transmits a TAU request message to the eNB 600 in step 703. In step 705, the eNB 600 transmits a TAU request message to the MME 300. The TAU procedure is performed along with an S-GW change, as defined in section 5.3.3.1 of 3GPP TS 23.401 in step 707.

[0079] In step 709, the MME 300 checks whether the current location information (TAI) about the UE 700 is included in an LA PDN TA list. In the absence of the current location information (TAI) about the UE 700 in the LA PDN TA list, the MME 300 triggers LA PDN disconnection. Thus, the MME 300 transmits a delete session request message to the S-GW 400 in step 711. The S-GW 400 transmits a delete session request message to the L-GW 500 in step 713. When the L-GW 500 deletes a session, the L-GW 500 transmits a delete session response message to the S-GW 400 in step 715 and then performs a PCC function along with the session deletion in step 717. Upon receipt of the session delete response message in step 715, the HSS 200 transmits a session delete response message to the MME 300 in step 719. In step 721, the MME 300 transmits a TAU accept message to the UE 700. The UE 700 transmits a TAU complete message to the MME 300 in step 723.

[0080] An LA PDN disconnection procedure according to an embodiment of the present invention will be described below.

[0081] The MME 300 and the UE 700 may maintain an LA PDN context until expiration of an LA PDN context retain timer, rather than they release an LA PDN connection according to an embodiment of the present disclosure. In the present disclosure, this operation mode is defined as LA PDN away mode.

[0082] Fig. 8 is a diagram illustrating a signal flow for a deferred LA PDN disconnection procedure according to an embodiment of the present disclosure.

[0083] Referring to Fig. 8, steps 801 to 807 are performed in the same manner as steps 701 to 707 of Fig. 7 and thus will not be described in detail herein. In step 809, the MME 300 determines whether current location information (TAI) about the UE 700 is included in an LA PDN TA list. In the absence of the current location information (TAI) about the UE 700, the MME 300 determines to switch to the LA PDN away mode and performs one of the following operations 1), 2), and 3) in relation to deferred LA PDN disconnection according to the state of the LA PDN context retain timer.

1) Registration of the LA PDN context retain timer: if the deferred LA PDN disconnection is enabled, the MME 300 defers release of an LA PDN connection. That is, the MME 300 registers the LA PDN context retain timer instead of releasing the LA PDN connection.

2) Deletion of the LA PDN context retain timer: if the UE 700 completes a TAU procedure before expiration of the LA PDN context retain timer in an LA, the MME 300 deletes the LA PDN context retain timer.

3) Expiration of the LA PDN context retain timer: if the LA PDN context retain timer expires without the TAU procedure of the UE 700 in the LA, the MME 300 performs the LA PDN disconnection procedure.

[0084] The MME 300 transmits a TAU accept message to the UE 700 in step 811 and the UE 700 transmits a TAU complete message to the MME 300 in step 723. The TAU accept message includes an LA PDN context retain command

and information about the LA PDN context retain timer. The UE 700 may be aware that the deferred LA PDN disconnection procedure is performed by checking the information included in the TAU accept message.

[0085] If the embodiment of Fig. 8 is implemented, even though the UE 700 moves out of the LA, when the MME 300 decides to maintain the LA PDN connection, the MME 300 may set the state of the LA PDN context to the LA PDN away mode. In this case, the MME 300 may transmit the TAU accept message with, for example, an LA PDN maintain action code indicator as the LA PDN context retain command and the value of the timer as the information about the LA PDN context retain timer to the UE 700 in step 811.

[0086] In the embodiment of the present disclosure, if the UE 700 returns to the LA in the LA PDN away mode, an LA PDN reconnection procedure may be performed. Then the MME 300 transmits an LA PDN context and a stored LA PDN bearer context during handover of the UE 700 in connected state or upon receipt of a service request from the UE 700 in idle state.

[0087] Fig. 9 is a diagram illustrating a signal flow for an LA PDN reconnection procedure according to an embodiment of the present disclosure. The LA PDN reconnection procedure is initiated by a service request from the UE 700 in the idle state.

[0088] Referring to Fig. 9, the UE 700 returns to an LA in the LA PDN away mode and thus performs a service request procedure to the eNB 600 in step 901. The eNB 600 transmits a service request of the UE 700 to the MME 300 in step 903. The service request is transmitted by NAS signaling. In step 905, the MME 300 and the HSS 200 perform an authentication security procedure. If the MME 300 determines that an LA PDN connection is still in the LA PDN away mode in the embodiment of the present disclosure, the MME 300 transmits an S1 initial context setup request message including the LA PDN context and the LA bear context to the eNB 600 in step 907.

[0089] In step 911, the UE 700 and the eNB 600 perform a radio bearer setup procedure related to an LA PDN connection. The eNB 600 transmits an initial context setup complete message to the MME 300 and a bearer modify request message for LA PDN reconnection to the S-GW 400 in step 913. In step 917, the S-GW 400 transmits the bearer modify request message to the L-GW 500. The L-GW 500 performs a PCC function for the LA PDN reconnection in step 919 and transmits a response message to the bearer modify request message to the S-GW 400 in step 921. The S-GW 400 transmits a response message to the bearer modify request message received in step 915 to the MME 300 in step 923.

[0090] Fig. 10 is a diagram illustrating a signal flow for an LA PDN reconnection procedure according to another embodiment of the present disclosure. The LA PDN reconnection procedure is triggered by handover of the UE 700 in the connected state.

[0091] Referring to Fig. 10, as the UE 700 returns to the LA in the LA PDN away mode, the UE 700 performs a handover procedure in connected mode in step 1001. The handover procedure is performed from a source eNB (S-eNB) outside the LA to a target eNB (T-eNB) within the LA, including a TAU procedure. In step 1003, the MME 300 determines whether current location information (TAI) about the UE 700 is included in an LA PDN context before expiration of the LA PDN context retain timer. In the presence of the current location information (TAI) about the UE 700 in the LA PDN context, the MME 300 determines whether the state of an LA PDN is the LA PDN away mode. If both of the conditions are satisfied, the MME 300 decides to reconfigure (reconnect) an LA PDN bearer. If the MME 300 decides to reconfigure the LA PDN bearer in step 1003, the MME 300 transmits a bearer setup request message including an LA PDN context and an LA bearer context to the T-eNB 600b in step 1005. Subsequently, an RRC reestablishment procedure is performed between the UE 700 and the T-eNB 600b in steps 1007 and 1009. In step 1011, the T-eNB 600b transmits a bearer setup response message indicating the bearer reconfiguration to the MME 300.

[0092] Fig. 11 is a block diagram of the UE 700 according to an embodiment of the present disclosure.

[0093] Referring to Fig. 11, the UE 700 includes a transmitter 1110 and a receiver 1130, which transmit and receive messages according to the embodiments illustrated in Figs. 1a to 10 in order to establish, maintain, release, or reestablish an LA PDN connection with the eNB 600 through a wireless network. The UE 700 further includes a controller 1150 that controls the transmission and reception of messages according to the embodiments illustrated in Figs. 1a to 10 to and from the eNB 600 in order to establish, maintain, release, or reestablish an LA PDN connection and provides overall control to the UE 700 so that the UE 700 may conduct communication in each communication state of an LA PDN.

[0094] Fig. 12 is a block diagram of the eNB 600 according to an embodiment of the present disclosure.

[0095] Referring to Fig. 12, the eNB 600 includes a first communication interface 1210 for transmitting and receiving messages to and from the UE 700 through a wireless network according to the embodiments of the present disclosure illustrated in Figs. 1a to 10 during establishment, maintenance, release, or reestablishment of an LA PDN connection in the UE 700, and a second communication interface 1230 for transmitting and receiving signals to and from other network entities of an EPS system such as another eNB or the MME 300 via a predetermined communication interface. The eNB 600 transmits and receives messages for establishment, maintenance, release, or reestablishment of an LA PDN connection in the UE 700 in predetermined procedures and participates in procedures such as current location information check, TAU, bearer establishment, and handover of the UE 700 in the LA PDN based on the transmitted and received messages according to the embodiments of the present disclosure illustrated in Figs. 1a to 10.

[0096] While not shown, the MME 300 may also be configured to include a communication interface for transmitting

and receiving messages to and from the UE 700 through a wireless network according to the embodiments of the present disclosure illustrated in Figs. 1a to 10 during establishment, maintenance, release, or reestablishment of an LA PDN connection in the UE 700, and a controller for controlling related operations.

5 Annex to the Description

[0097] Certain exemplary embodiments of the present invention provide one or more methods, User Equipments, Mobility Management Entities and/or Base Stations according to one or more of the following numbered clauses.

10 [Clause 1] A method for establishing a Packet Data Network (PDN) connection by a User Equipment (UE) in a wireless communication system, the method comprising:

receiving Local Area (LA) PDN subscription information from an operator server;
 15 determining whether current location information about the UE is included in the LA PDN subscription information;
 and
 in the presence of the current location information about the UE in the LA PDN subscription information, starting an LA PDN establishment procedure.

20 [Clause 2] The method of clause 1, wherein the current location information about the UE includes a current Tracking Area Indication (TAI) of the UE.

[Clause 3] The method of clause 1, further comprising, if the LA PDN subscription information is updated, receiving from a Mobility Management Entity (MME) information indicating that the LA PDN subscription information is updated.

25 [Clause 4] The method of clause 1, wherein the LA PDN subscription information includes at least one of a TA list, an LA Access Point Name (LA APN), an LA Identifier (LA ID), additional information, and existing PDN configuration data.

30 [Clause 5] The method of clause 1, wherein the LA PDN establishment procedure is triggered by one of an initial attach procedure, a TAU procedure, and a handover and TAU procedure.

35 [Clause 6] The method of clause 1, wherein the starting of an LA PDN establishment procedure comprises transmitting a PDN connectivity request message including the current location information about the UE to an MME, and wherein in the presence of the current location information about the UE in an LA PDN context, the MME performs a PDN connectivity procedure.

[Clause 7] A User Equipment (UE) for establishing a Packet Data Network (PDN) connection in a wireless communication system, the UE comprising:

40 a receiver configured to receive Local Area (LA) PDN subscription information from an operator server; and
 a controller configured to determine whether current location information about the UE is included in the LA PDN subscription information, and in the presence of the current location information about the UE in the LA PDN subscription information, to control starting of an LA PDN establishment procedure.

45 [Clause 8] The UE of clause 7, wherein the current location information about the UE includes a current Tracking Area Indication (TAI) of the UE.

50 [Clause 9] The UE of clause 7, wherein if the LA PDN subscription information is updated, the controller further controls reception of information indicating that the LA PDN subscription information is updated from a Mobility Management Entity (MME).

[Clause 10] The UE of clause 7, wherein the LA PDN subscription information includes at least one of a TA list, an LA Access Point Name (LA APN), an LA Identifier (LA ID), additional information, and existing PDN configuration data.

55 [Clause 11] The UE of clause 7, wherein the LA PDN establishment procedure is triggered by one of an initial attach procedure, a TAU procedure, and a handover and TAU procedure.

[Clause 12] The UE of clause 7, further comprising a transmitter configured to transmit a message for LA PDN

establishment to a network,

wherein when the LA PDN the controller controls transmission of a PDN connectivity request message including the current location information about the UE to an MME, and
 wherein in the presence of the current location information about the UE in an LA PDN context, the MME performs a PDN connectivity procedure.

[Clause 13] A method for updating subscription information about a User Equipment (UE) by a Mobility Management Entity (MME) that manages mobility of the UE in a wireless communication system, the method comprising:

if Local Area (LA) Packet Data Network (PDN) subscription information about the UE is updated, receiving the updated LA PDN subscription information from an operator server;
 determining whether current location information about the UE is included in an LA PDN context including a Tracking Area (TA) list of the UE; and
 in the presence of the current location information about the UE in the LA PDN context, transmitting information indicating the update of the LA PDN subscription information to the UE.

[Clause 14] The method of clause 13, wherein in the presence of the current location information about the UE in the LA PDN context, the operator server provides the updated LA PDN subscription information to the UE.

[Clause 15] A Mobility Management Entity (MME) for managing mobility of a User Equipment (UE) in a wireless communication system, the MME comprising:

a communication interface configured to transmit and receive messages for updating Local Area (LA) Packet Data Network (PDN) subscription information; and
 a controller configured, if LA PDN subscription information about the UE is updated, to control reception of the updated LA PDN subscription information from an operator server, to determine whether current location information about the UE is included in an LA PDN context including a Tracking Area (TA) list of the UE, and in the presence of the current location information about the UE in the LA PDN context, to control transmission of information indicating the update of the LA PDN subscription information to the UE.

[Clause 16] The MME of clause 15, wherein in the presence of the current location information about the UE in the LA PDN context, the operator server provides the updated LA PDN subscription information to the UE.

[Clause 17] A communication method of a Base Station (BS) during handover of a User Equipment (UE) using a Packet Data Network (PDN) in a wireless communication system, the communication method comprising:

if the UE performs handover to a target BS within a Local Area (LA) in connected state, determining whether current location information about the UE is included in an LA PDN context; and
 in the presence of the current location information about the UE in the LA PDN context, transmitting a handover request message including an LA PDN context related to the handover to the target BS.

[Clause 18] The communication method of clause 17, wherein the BS and the target BS are located in the same LA.

[Clause 19] The communication method of clause 17, wherein the LA PDN context related to the handover includes an LA PDN context and an LA PDN bearer context, the LA PDN context including an LA Identifier (ID) and a Tracking Area (TA) list and the LA PDN bearer context including related bearer IDs.

[Clause 20] The communication method of clause 17, wherein the handover is one of X2 handover and S1 handover in an Evolved Packet System (EPS).

[Clause 21] A Base Station (BS) for supporting handover of a User Equipment (UE) using a Packet Data Network (PDN) in a wireless communication system, the BS comprising:

a communication interface configured to transmit and receive messages related to the handover of the UE; and
 a controller configured, if the UE performs handover to a target BS within a Local Area (LA) in connected state, to determine whether current location information about the UE is included in an LA PDN context, and in the presence of the current location information about the UE in the LA PDN context, to transmit a handover request

message including an LA PDN context related to the handover to the target BS.

[Clause 22] The BS of clause 21, wherein the BS and the target BS are located in the same LA.

[Clause 23] The BS of clause 21, wherein the LA PDN context related to the handover includes an LA PDN context and an LA PDN bearer context, the LA PDN context including an LA Identifier (ID) and a Tracking Area (TA) list and the LA PDN bearer context including related bearer IDs.

[Clause 24] The BS of clause 21, wherein the handover is one of X2 handover and S1 handover in an Evolved Packet System (EPS).

[Clause 25] A method for releasing a Packet Data Network (PDN) connection by a Mobility Management Entity (MME) that manages mobility of a User Equipment (UE) in a wireless communication system, the method comprising:

receiving a Tracking Area Update (TAU) request from the UE;
determining whether current location information about the UE is included in a Local Area (LA) PDN TA list; and
in the absence of the current location information about the UE in the LA PDN TA list, starting an LA PDN disconnection procedure.

[Clause 26] A method for releasing a Packet Data Network (PDN) connection by a Mobility Management Entity (MME) that manages mobility of a User Equipment (UE) in a wireless communication system, the method comprising:

determining whether current location information about the UE is included in a Local Area (LA) PDN Tracking Area (TA) list; and
in the absence of the current location information about the UE in the LA PDN TA list, maintaining an LA PDN context of the UE until expiration of an LA PDN context retain timer.

[Clause 27] The method of clause 26, further comprising:

receiving a Tracking Area Update (TAU) request message from the UE; and
transmitting a TAU accept message including an LA PDN context retain command and the LA PDN retain timer to the UE.

[Clause 28] A method for reestablishing a Packet Data Network (PDN) connection by a Mobility Management Entity (MME) that manages mobility of a User Equipment (UE) in a wireless communication system, the method comprising:

receiving a service request message from the UE that returns to a Local Area (LA);
transmitting an initial context setup request message including an LA PDN context and an LA bearer context of the UE to a Base Station (BS); and
transmitting a bearer modify request for LA PDN reconnection of the UE to a serving gateway.

[Clause 29] A method for reestablishing a Packet Data Network (PDN) connection by a Mobility Management Entity (MME) that manages mobility of a User Equipment (UE) in a wireless communication system, the method comprising:

receiving a Tracking Area Update (TAU) request from the UE that performs handover in connected state from a source Base Station (BS) outside a Local Area (LA) to a target BS within the LA;
determining whether current location information about the UE is included in an LA Packet Data Network (PDN) context before expiration of an LA PDN context retain timer; and
in the presence of the current location information about the UE in the LA PDN context, transmitting to the target BS a bearer setup request including an LA PDN context and a bearer context.

Claims

1. A method for establishing a packet data network, PDN, connection by a user equipment, UE, (700) in a wireless communication system, the method comprising:

obtaining (213) subscription information associated with a local area, LA, PDN;

determining (215) whether a current location of the UE is included in at least one service area for the LA PDN of the subscription information; and
 performing (217) an PDU session establishment procedure for the LA PDN, if the current location information of the UE is included in the at least one service area for the LA PDN of the subscription information,
 wherein when the UE (700) moves out of the at least one service area for the LA PDN after a session for the LA PDN is established using the PDU session establishment procedure, the session for the LA PDN is deactivated, and
 wherein the subscription information comprises a tracking area, TA.

2. The method of claim 1, wherein the PDU session establishment procedure for the LA PDN is not performed, if the current location information of the UE is not included in the at least one service area for the LA PDN of the subscription information.

3. The method of claim 1, wherein a local area access point name, LA APN, is further identified by the UE (700).

4. The method of claim 1, wherein the performing of the PDU session establishment procedure comprises:
 transmitting a request for the PDU session establishment procedure for the LA PDN corresponding to the current location of the terminal if the current location information of the UE is included in the at least one service area for the LA PDN of the subscription information.

5. The method of claim 1, wherein the information on the at least one service area is provided to the UE (700).

6. A user equipment, UE (700) for establishing a packet data network, PDN, connection in a wireless communication system, the UE comprising:

a transceiver (1110, 1130); and
 a controller (1150) configured to:

obtain subscription information associated with a local area, LA, PDN;
 determine whether a current location of the UE is included in at least one service area for the LA PDN of the subscription information; and
 perform an PDU session establishment procedure for the LA PDN, if the current location information of the UE is included in the at least one service area for the LA PDN of the subscription information,
 wherein when the UE (700) moves out of the at least one service area for the LA PDN after a session for the LA PDN is established using the PDN session establishment procedure, the session for the LA PDN is deactivated, and
 wherein the subscription information comprises a tracking area, TA.

7. The UE of claim 6, wherein the PDU session establishment procedure for the LA PDN is not performed, if the current location information of the UE is not included in the at least one service area for the LA PDN of the subscription information.

8. The UE of claim 6, wherein a local area access point name, LA APN, is further identified by the UE (700).

9. The UE of claim 6, the controller(1150) is further configured to:
 transmit a request for the PDU session establishment procedure for the LA PDN corresponding to the current location of the terminal if the current location information of the UE is included in the at least one service area for the LA PDN of the subscription information.

10. The UE of claim 6, wherein the information on the at least one service area is provided to the UE (700).

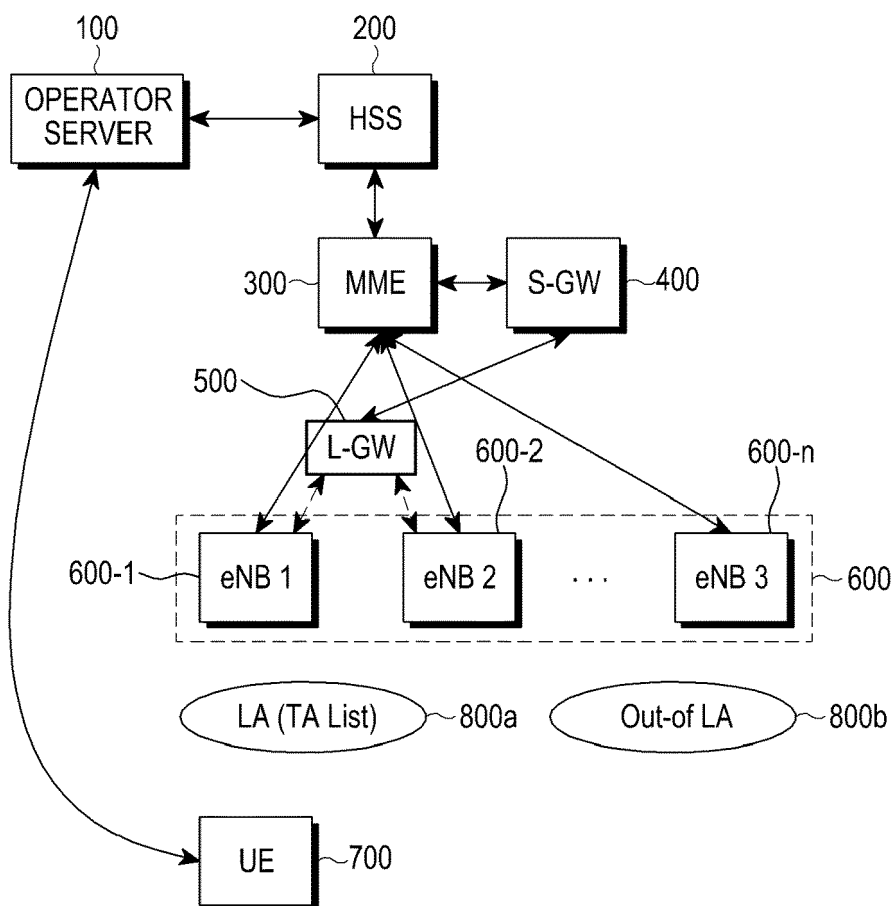


FIG. 1A

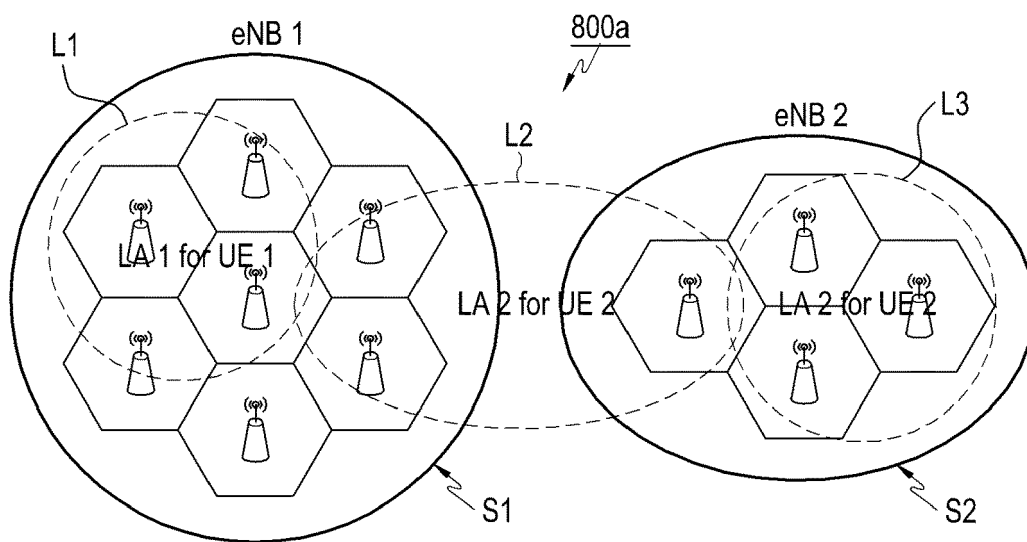


FIG. 1B

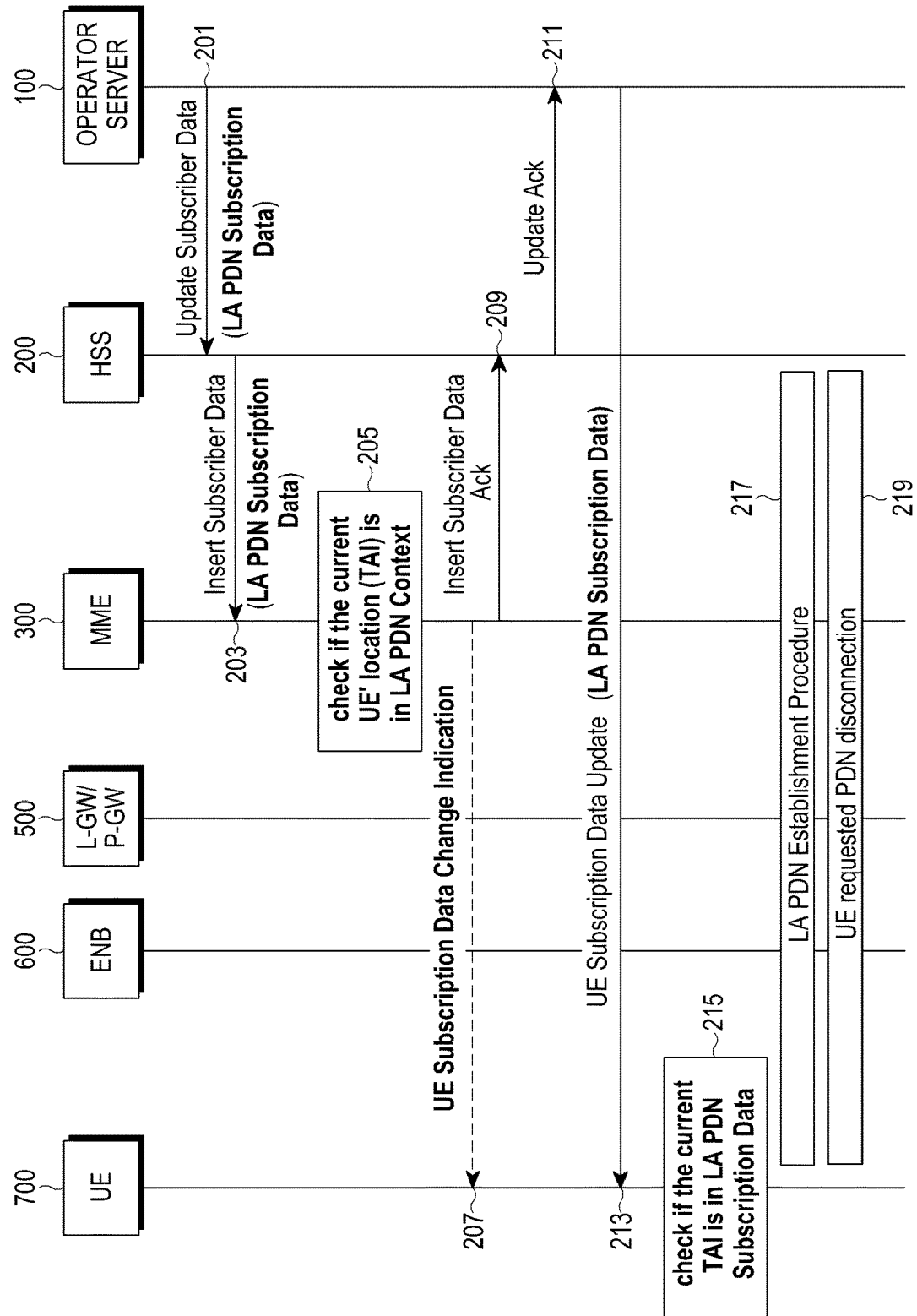


FIG.2

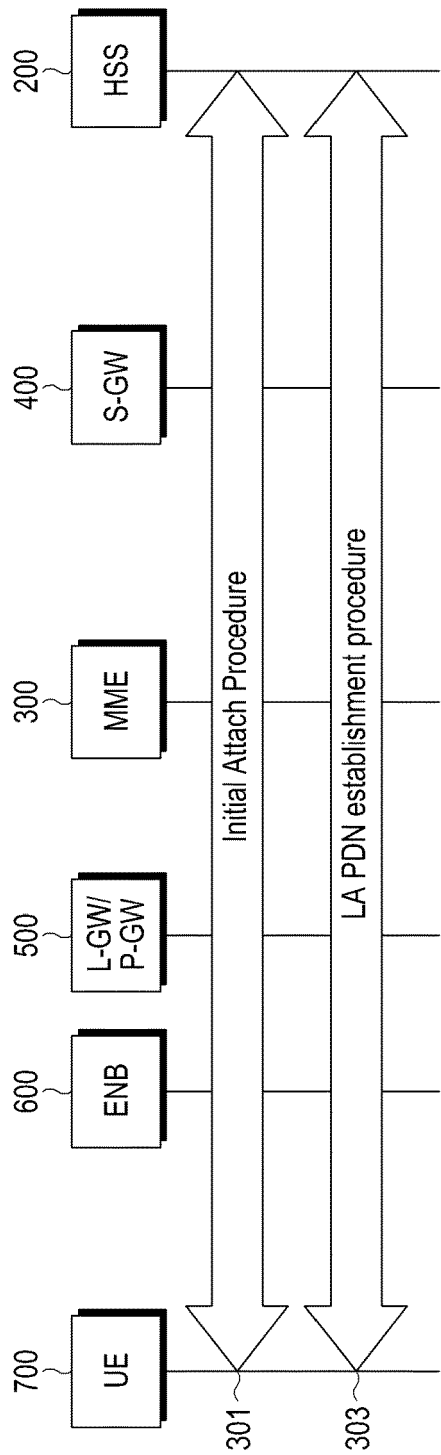


FIG.3A

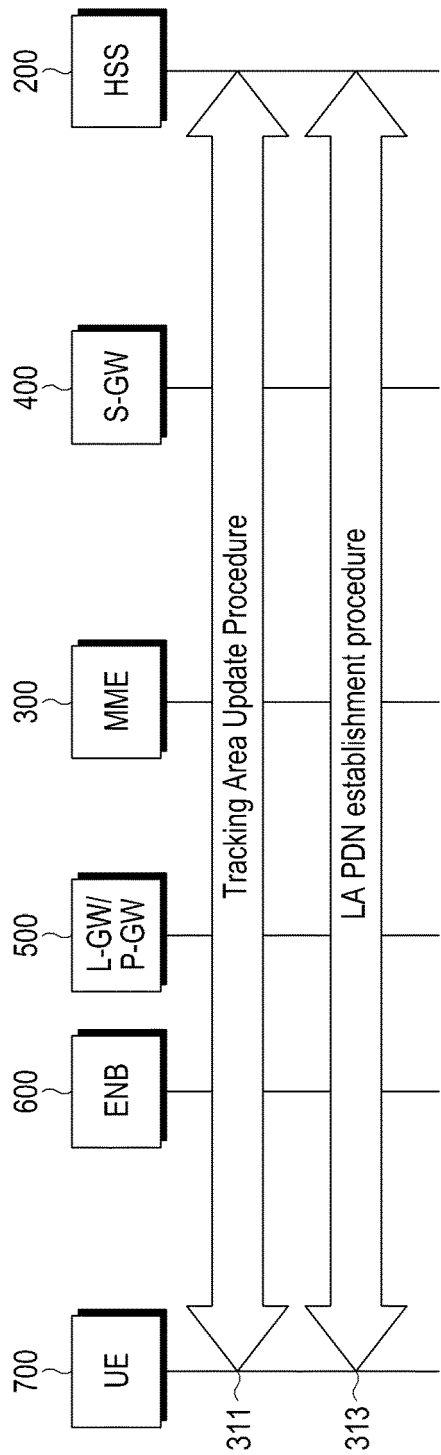


FIG.3B

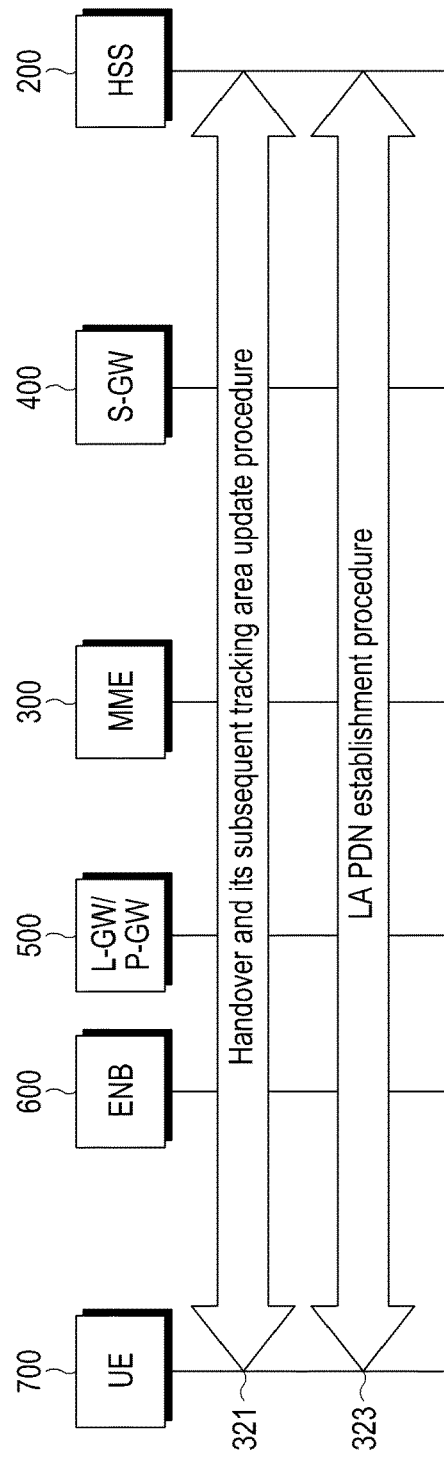


FIG.3C

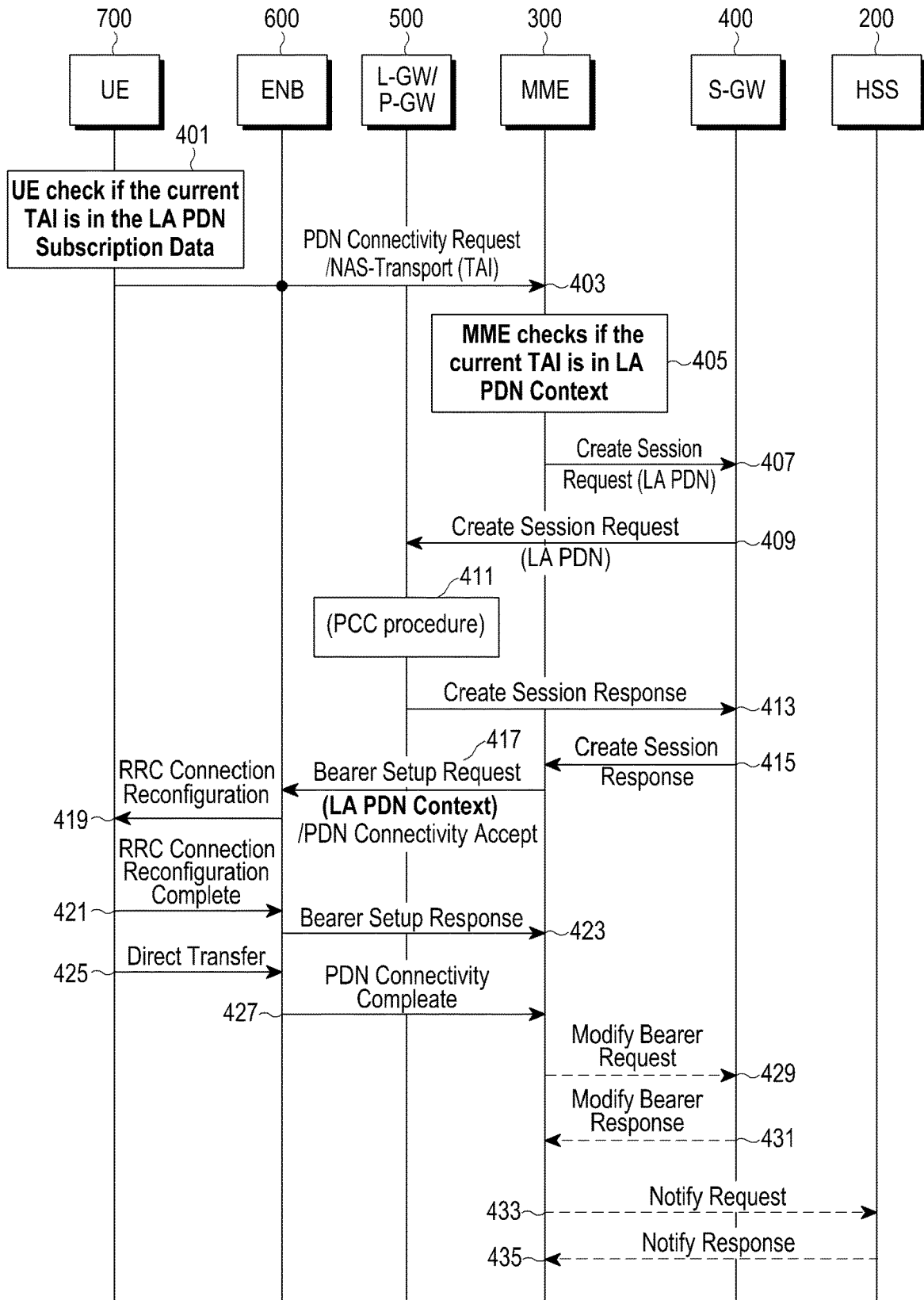


FIG.4

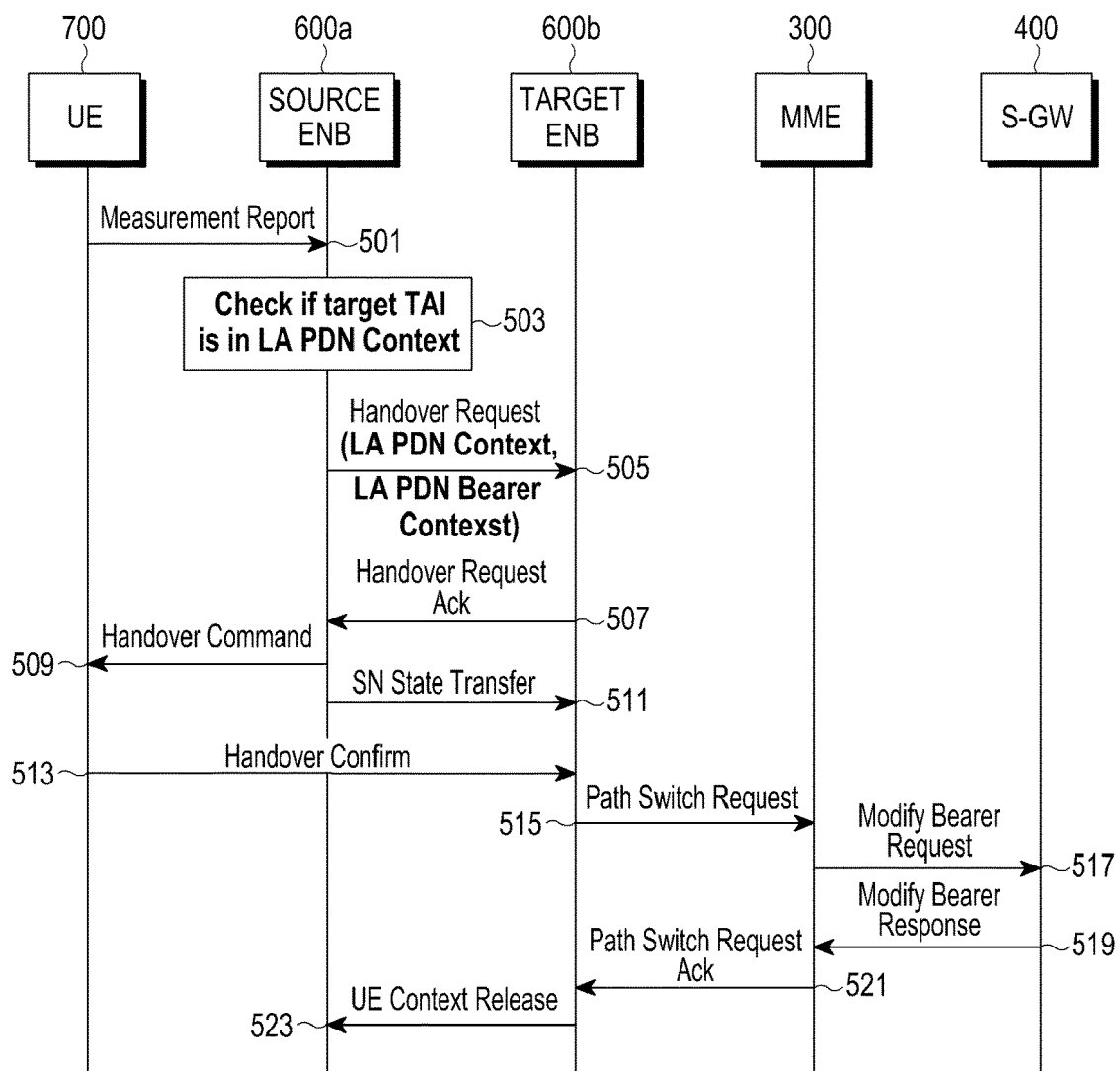


FIG.5

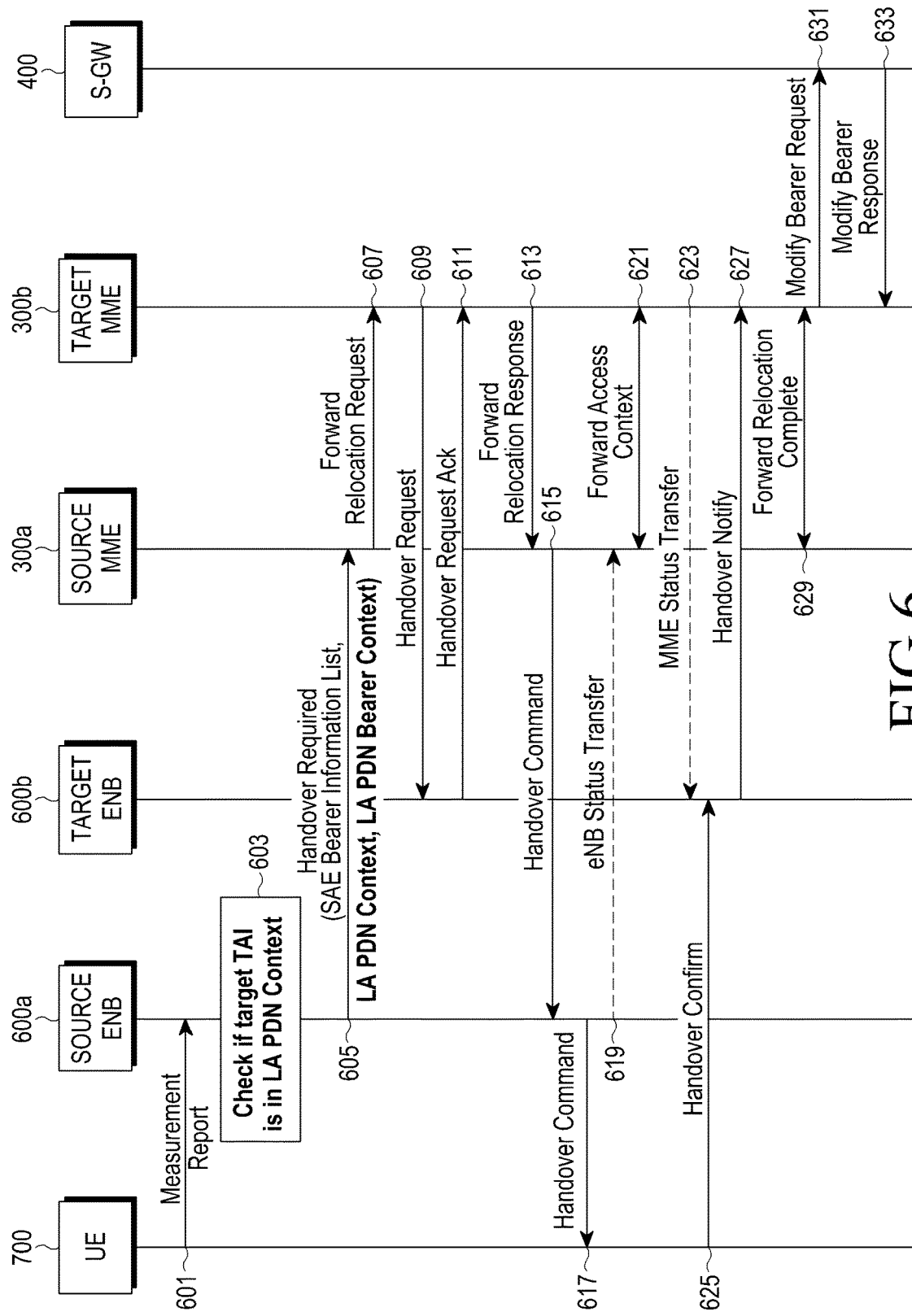


FIG.6

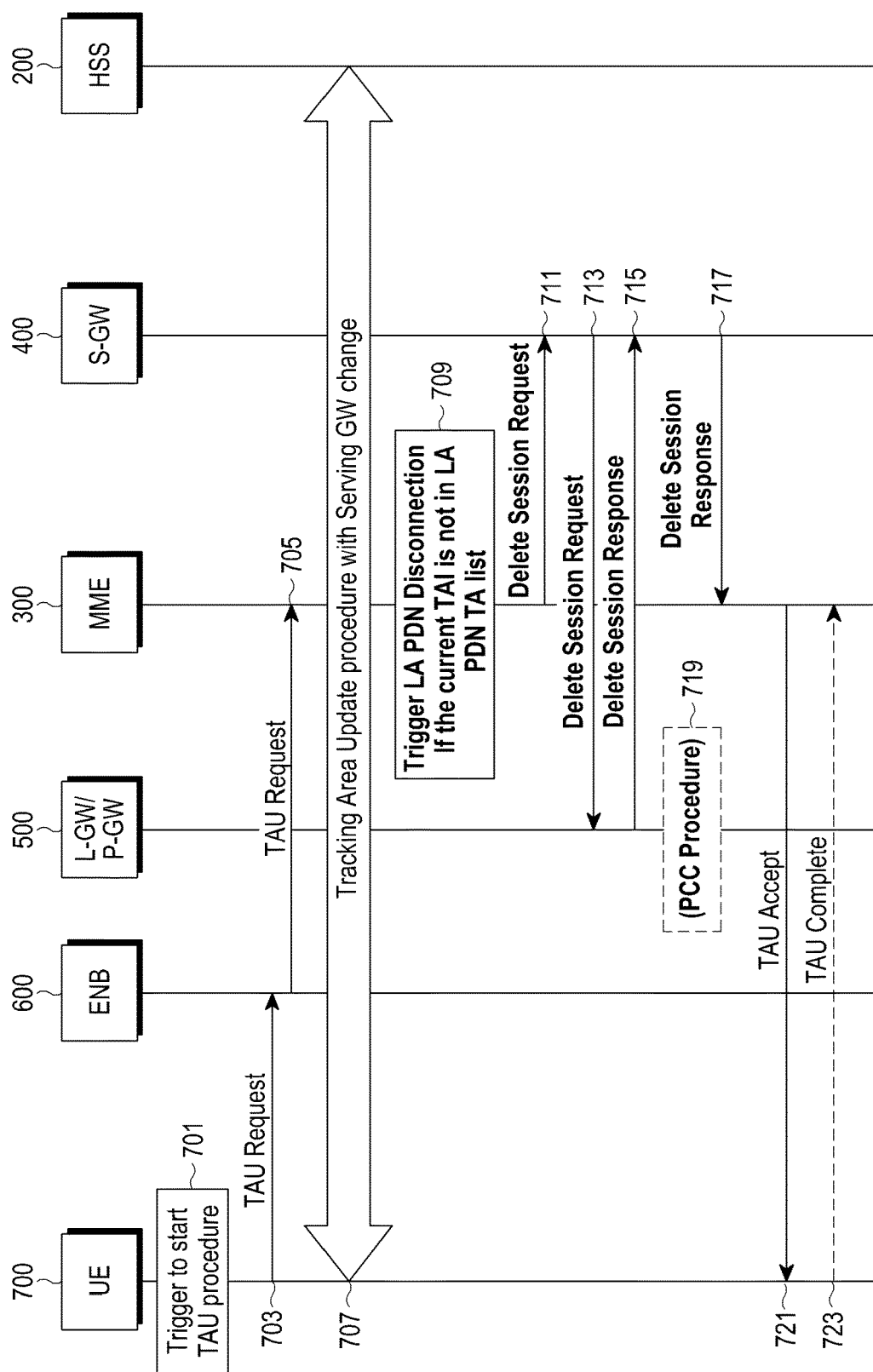


FIG.7

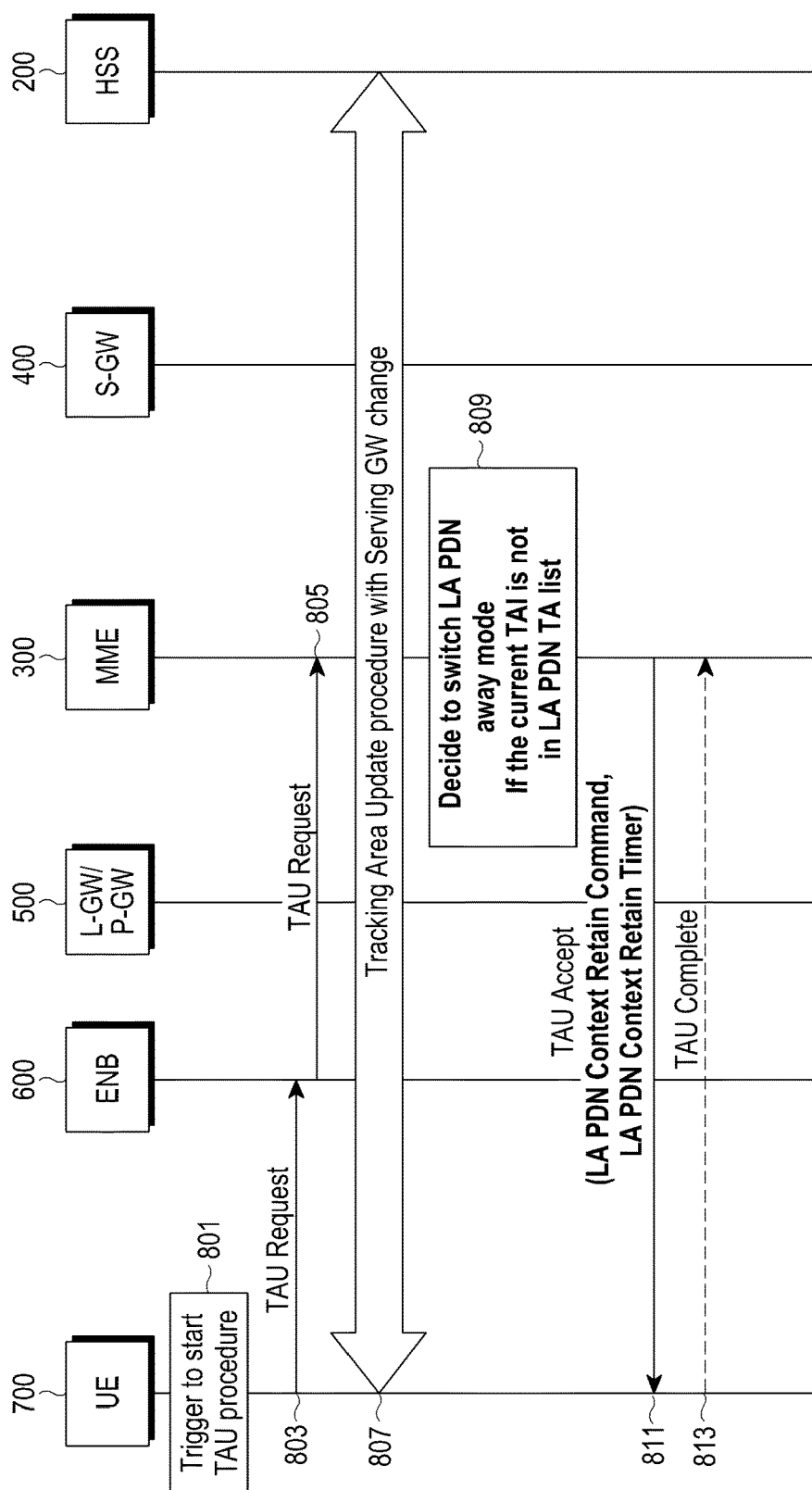


FIG.8

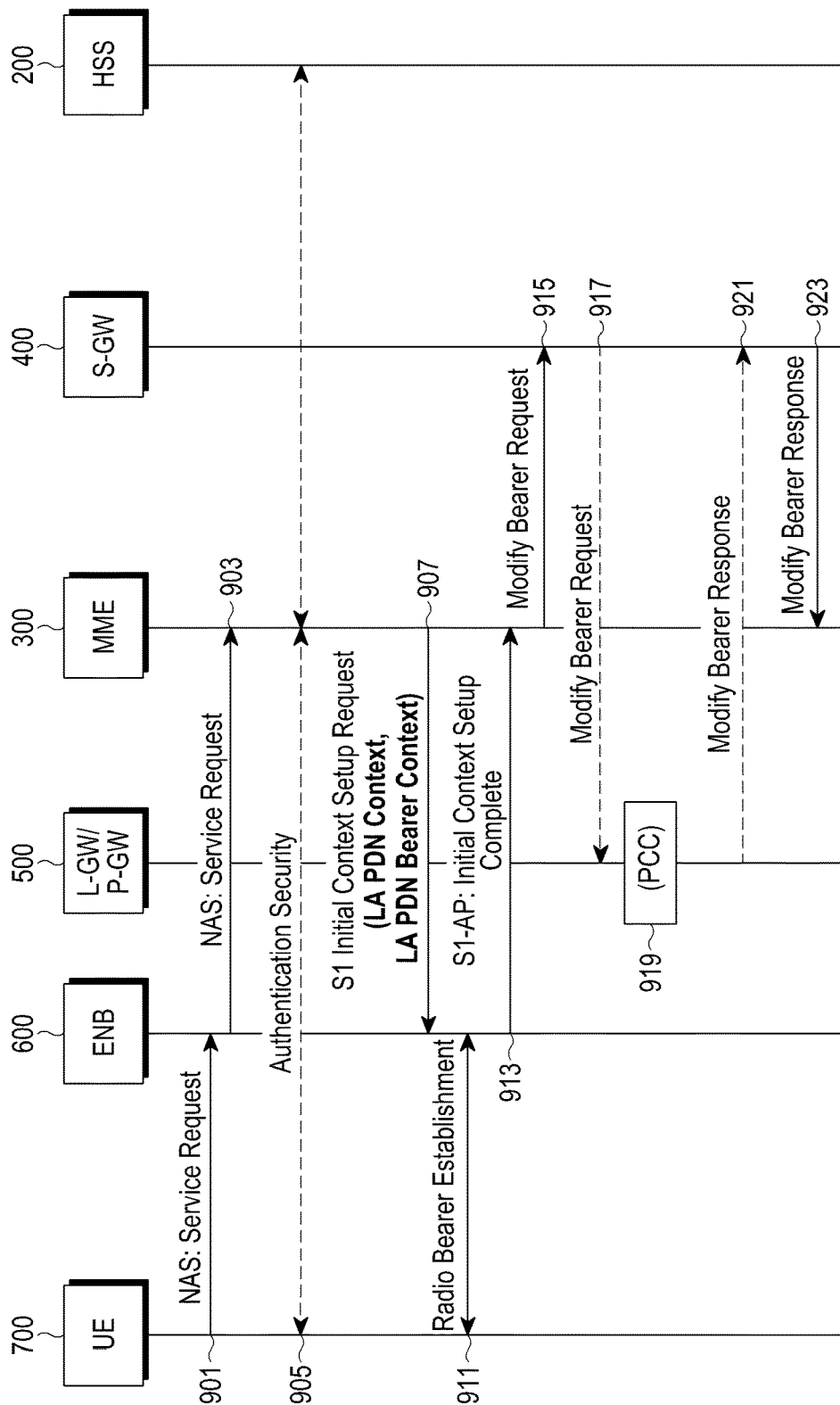


FIG.9

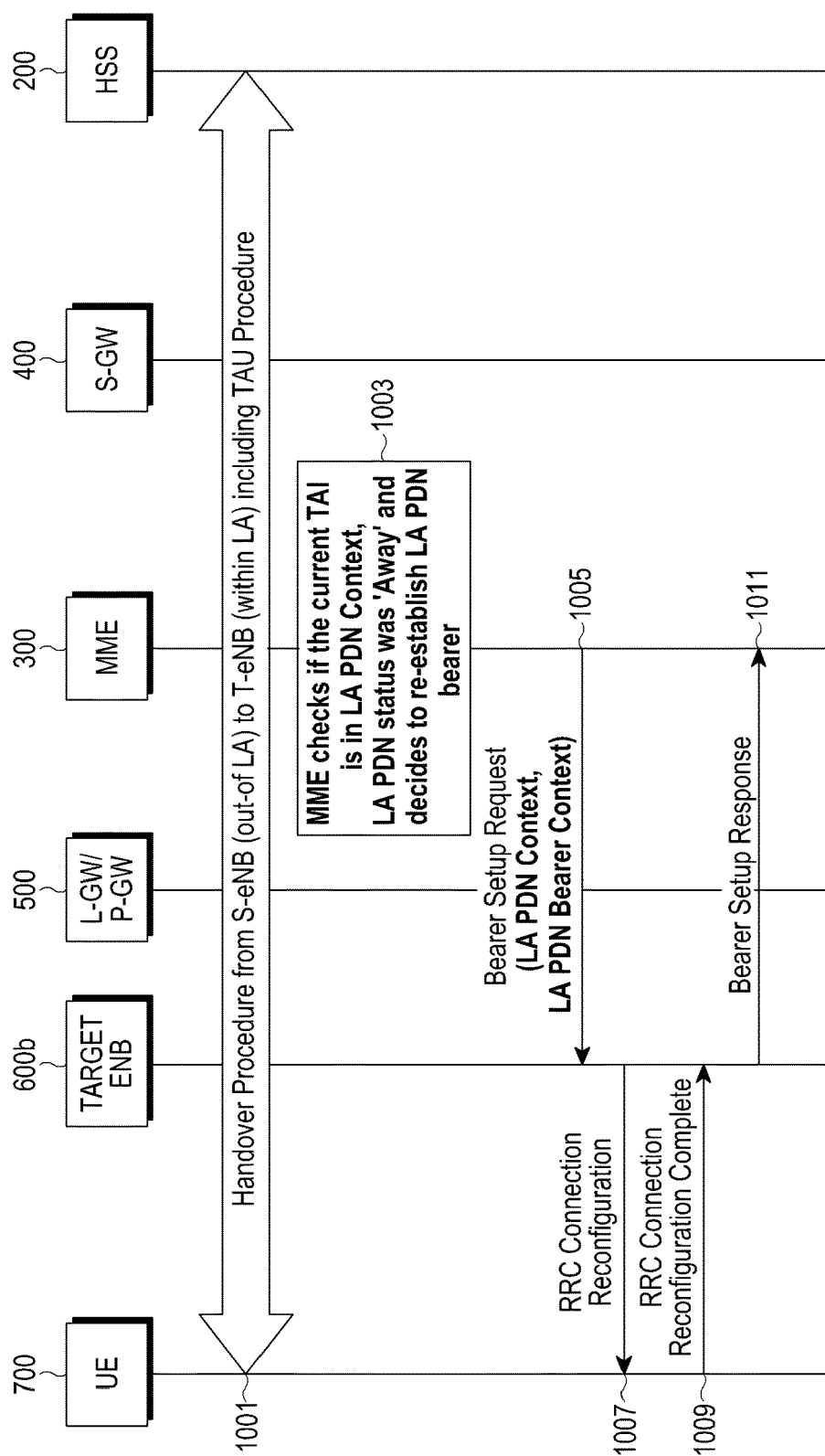


FIG.10

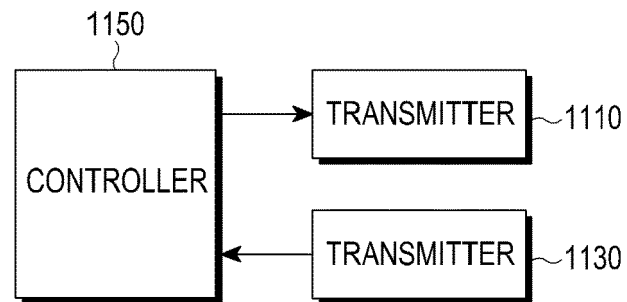


FIG.11

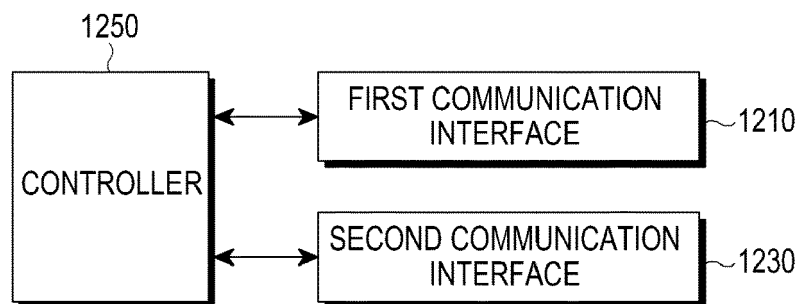


FIG.12



EUROPEAN SEARCH REPORT

Application Number

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| Place of search Munich | | Date of completion of the search 23 February 2022 | Examiner Aulló Navarro, A |
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ON EUROPEAN PATENT APPLICATION NO.**

EP 21 20 7589

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